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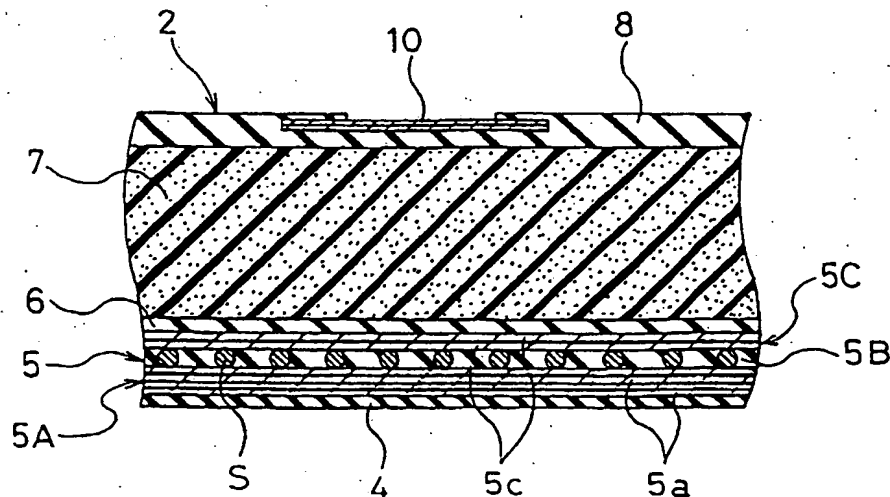
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(54) Abstract Title

Hose deterioration measuring method

(57) A deterioration measuring method of a hose 1 which comprises the steps of disposing a fibre-reinforced test body 10 in a retrievable position of the hose, the test body 10 being substantially identical in material and structure to an inner fibre-reinforced layer 5 of the hose 1; retrieving at least one part of the test body 10 after the hose 1 has been used for a period of time, measuring the change of physical properties of the retrieved test body 10 after the passage of time and estimating a deterioration state of the fibre-reinforced layer 5 from the changes of the physical properties with the passage of time.

FIG. 3



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FIG. 1

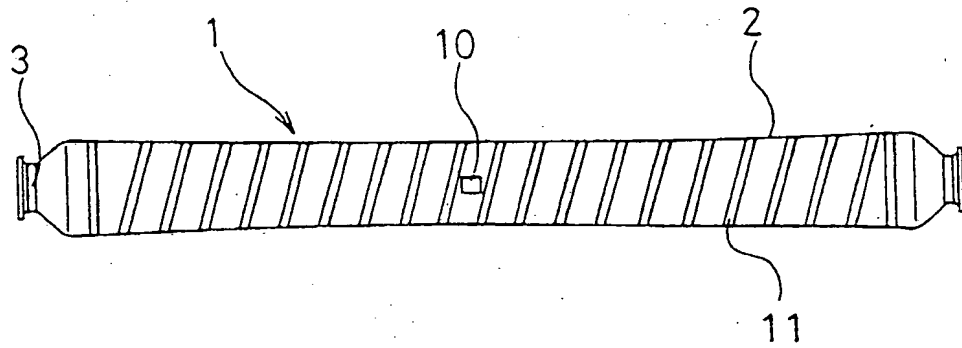


FIG. 2

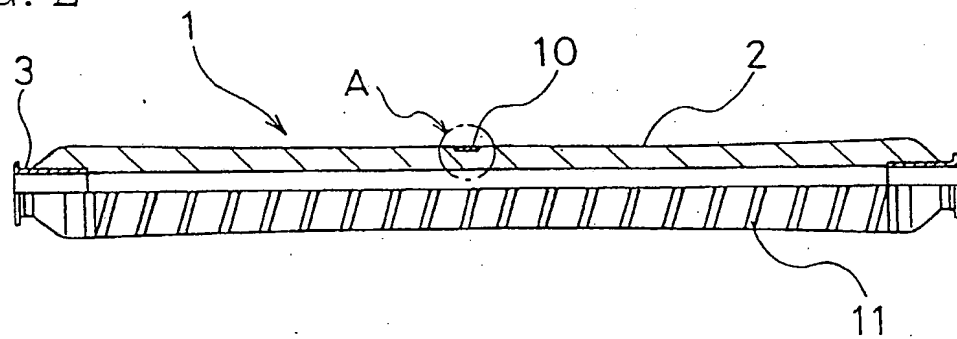
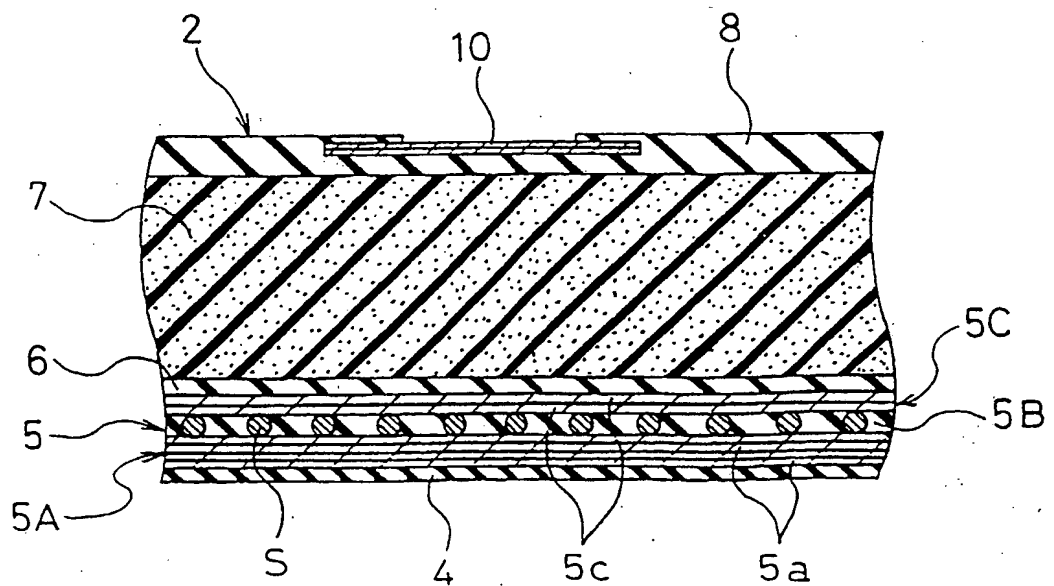


FIG. 3



HOSE DETERIORATION MEASURING METHOD

Background of the Invention

The present invention relates to a hose deterioration measuring method and more specifically, to a hose deterioration measuring method in which a deterioration state of a fiber-reinforced layer of the hose can be estimated without destroying the hose.

For example, if fluid transferring hoses (marine hoses) utilised for transferring fluid such as oil to and from a tanker anchored offshore are burst during a transferring operation, there is a risk that spillage of oil or the like may cause a massive environmental pollution in surrounding areas, thus developing an enormous social problem. For this reason, it is vital to replace the fluid transferring hoses with new ones before they are largely deteriorated by usage, in order to prevent pollution of the fluid transferring hoses and to obviate occurrence of a major accident.

The fluid transferring hose as described above generally has a structure with a plurality of fiber-reinforced layers functioning as pressure withstanding layers provided between an internal rubber layer and a covering rubber layer. The fluid would be spilled out if the fiber-reinforced layers were broken by fatigue cause by wave and current. Therefore, a deterioration state of the hose is highly dependent on a deterioration state of the fiber-reinforced layers thereof.

Conventionally, in the case of checking fluid transferring hoses for their deterioration states, at least one fluid transferring hose that has been used for a certain period of time was detached out of a hose line (a junction of numerous fluid transferring hoses disposed on and in the sea) and then destroyed, whereby the deterioration state of the hose was judged from measuring physical properties of fiber-reinforced layers such as tensile strength and elongation. A usable period of the hoses has been estimated from this, whereby a replacement term of the hoses of the hose line has been decided.

Also, such measurement has been carried out several times in different terms, and data for the physical properties of the fiber-reinforced layers have been plotted on a graph in

order to determine reduction of the fluid transferring hose performance with passage of time, whereby the usable period has been estimated.

However, in the above-described method of destroying the fluid transferring hose in order to check for the deterioration state, a replacement operation of detaching one or more fluid transferring hoses out of the hose line and fitting new fluid transferring hoses thereto is required on the sea. In addition, a destroyed hose cannot be reused. Accordingly, there has been a problem that checking the hose for its deterioration state is very costly.

The problem is applied not only to the above-described fluid transferring hose, but also to hoses for other uses in which at least one fiber-reinforced layer is provided between an internal rubber layer and a covering rubber layer thereof.

Summary of the Invention

An object of the present invention is to provide a hose deterioration measuring method which can estimate a deterioration state of a fiber-reinforced layer of the hose without destroying the hose.

Another object of the present invention is to provide a hose deterioration measuring method which can reduce the cost of checking hose deterioration.

A deterioration measuring method of a hose according to the present invention is characterised by comprising the steps of: disposing at least one fiber-reinforced layer test body in a retrievable position of the hose in which at least one fiber-reinforced layer composed of fiber cords covered with rubber is provided between an internal rubber layer and a covering rubber layer, the fiber-reinforced layer test body being substantially identical in material and structure to the fiber-reinforced layer; retrieving at least one part of the fiber-reinforced layer test body after being used for a certain period of time; measuring changes of physical properties of the retrieved fiber-reinforced layer test body with the passage of time; and estimating a deterioration state of the fiber-reinforced layer from the changes of the physical properties with the passage of time.

By providing the fiber-reinforced layer test body that is virtually identical in material and structure to the fiber-reinforced layer in a retrievable position, the fiber-reinforced layer

test body undergoes changes of the physical properties with the passage of time, which are virtually identical to those of the fiber-reinforced layer. Accordingly, by retrieving the fiber-reinforced layer test body and by measuring the changes of the physical properties with the passage of time, the changes of the physical properties of the fiber-reinforced layer with the passage of time can be ascertained with a high level of accuracy. Therefore, it is possible to estimate the deterioration state of the fiber-reinforced layer without destroying the hose. In addition, a detaching operation of the hose is not required and the hose checked for its deterioration state is continuously usable. Accordingly, the cost for the measurement of the deterioration state can be reduced.

Brief Description of the Drawings

Fig. 1 is a plan view showing an example of a hose.

Fig. 2 is a front view with a half section of the hose of Fig. 1.

Fig. 3 is an enlarged sectional view of a portion indicated by the arrow A in Fig. 2.

Detailed Description of the Preferred Embodiment

In the drawings, a hose 1 represents a fluid transferring hose utilised for transferring fluids such as oil to and from a tanker. The hose 1 includes a hose main body 2 and fixing flanges 3 provided on both ends thereof. As shown in Fig. 3, in the hose main body 2, a reinforced layer group 5 is laminated tubularly on an outer periphery of a tubular internal rubber layer 4. On an outer periphery of the reinforced layer group 5, a tubular covering rubber layer 8 is provided via a tubular base covering rubber layer 6 and a tubular floating layer 7 composed of sponge rubber or the like for floating the hose.

The reinforced layer group 5 comprises a first fiber-reinforced layer group 5A disposed on the outer periphery of the internal rubber layer 4, one wire-reinforced layer 5B disposed on an outer periphery of the first fiber-reinforced layer group 5A, and a second fiber-reinforced layer group 5C disposed on an outer periphery of the wire-reinforced layer 5B.

The first fiber-reinforced layer group 5A includes four fiber-reinforced layers 5a composed of fiber cords arranged aslant with respect to a longitudinal direction of the hose and covered with rubber. Fiber cords of the adjacent fiber-reinforced layers 5a have inverse inclinations with respect to the longitudinal direction of the hose so that they cross each other. The wire-reinforced layer 5B has a steel wire S spirally wound around the first fiber-reinforced layer group. The second fiber-reinforced layer group 5C comprises two fiber-reinforced layers 5c composed of fiber cords arranged aslant with respect to a longitudinal direction of the hose and covered with rubber. Similarly to the fiber-reinforced layers 5a of the first fiber-reinforced layer group 5A, fiber cords of the two adjacent fiber-reinforced layers 5c have inverse inclinations with respect to the longitudinal direction of the hose so that they cross each other. As for the fiber-reinforced layers 5a and 5c of the first fiber-reinforced layer group 5A and the second fiber-reinforced layer group 5C, the fiber cords thereof are arranged aslant with respect to the longitudinal direction of the hose in order to function as pressure-withstanding layers and as tension-withstanding layers. Accordingly, it is desirable to provide the layers of an even number, reckoning two layers crossing each other as a pair.

Two layers of fiber-reinforced layer test bodies 10, each of which is virtually identical in material and structure to the fiber-reinforced layer of the reinforced layer group 5, are buried in the covering rubber layer 8 at a central portion of the hose main body 2. Each of the fiber-reinforced layer test bodies 10 comprises fiber cords arranged aslant with respect to a longitudinal direction of the hose and covered with rubber. The fiber cords in the two layers of the fiber-reinforced layer test bodies 10 have inverse inclinations with respect to the longitudinal direction of the hose hence they cross each other. A portion of rubber of the covering rubber layer 8 over an outer periphery of the fiber-reinforced layer test bodies 10 is removed so that the outer periphery of the fiber-reinforced layer test bodies 10 is exposed towards an outer peripheral surface side of the covering rubber layer 8, thus facilitating retrieval of the fiber-reinforced layer test bodies 10 when deterioration measurement of the hose 1 is carried out.

In the drawings, a reference numeral 11 denotes orange-coloured stripes formed spirally on the outer peripheral surface of the covering rubber layer 8 for the purpose of facilitating confirmation of a position of the hose 1 on the sea.

In a deterioration measurement method of the present invention of the hose 1 described above, at least one part of a layer of the fiber-reinforced layer test bodies 10 or the whole fiber-reinforced test bodies 10 can be retrieved after the hose 1 is used for a certain period of time. Next, changes with the passage of time regarding physical properties of the fiber cords and the rubber of the part of or the whole fiber-reinforced layer test bodies retrieved are measured. A deterioration state of the fiber-reinforced layers of the reinforced layer group 5 can be estimated from the changes of the physical properties with the passage of time, thus reckoning it as a deterioration state of the hose.

According to the present invention, since the fiber-reinforced layer test bodies 10 virtually identical in material and structure to the fiber-reinforced layers are fixed to the hose main body 2, the fiber-reinforced layer test bodies 10 will experience the changes of the physical properties with the passage of time that are virtually identical to those of the fiber-reinforced layers of the reinforced layer group 5. Therefore, the changes of the physical properties with the passage of time regarding the fiber-reinforced layers of the reinforced layer group 5 can be ascertained with a high level of accuracy by measuring the changes of the physical properties with the passage of time regarding the fiber-reinforced layer test body 10. Accordingly, the deterioration state of the fiber-reinforced layers can be readily estimated without destroying the hose 1. Residual destructive pressure of the hose 1 can be calculated from this, accordingly, setting an appropriate term for hose replacement becomes feasible. Moreover, the replacement term of the hose 1 can be determined more precisely by retrieving the part of the fiber-reinforced layer test body 10 regularly. In addition, since an operation for detaching the hose is not required and the hose checked for its deterioration state remains continuously usable, a cost for measuring the deterioration state can be largely reduced.

In the present invention, the above-described embodiment shows an example in which the fiber-reinforced layer test bodies 10 are provided in the covering rubber layer 8.

However, the fiber-reinforced layer test bodies 10 may be alternatively buried in the floating layer 7, or they may be fixed onto the peripheral surface of the covering rubber layer 8 with adhesive and the like. The fiber-reinforced layer test bodies 10 may be disposed at any positions as far as they are disposed in an area not inhibiting performance of the hose as well as they are retrievable in the event of the deterioration measurement of the hose 1. It is preferable to dispose the fiber-reinforced layer test bodies 10 on a side that is more outward than the reinforced layer group 5.

In the case where the fiber-reinforced layer test bodies 10 are disposed so as to be exposed toward the outer peripheral surface side of the covering rubber layer 8, it is preferable that at least the exposed surface of the fiber-reinforced layer test bodies 10 is covered with a flexible material made of rubber, resin or the like. This will prevent the fiber-reinforced layer test bodies 10 from deteriorating with sea water, sunlight, ozone and the like, thus rendering the deterioration state of the fiber-reinforced layer test bodies 10 more approximate to the deterioration state of the fiber-reinforced layers of the reinforced layer group 5.

Since the central portion of the fluid transferring hose 1 tends to receive the largest distortion and to deteriorate to the largest extent, it is preferable to dispose the fiber-reinforced layer test bodies 10 at the central portion of the hose main body 2, as described above. In a case of a hose in which a portion other than its central portion deteriorates to the largest extent, then it is preferable to provide the fiber-reinforced layer test body 10 at that portion where it deteriorates to the largest extent.

Although the present invention has been illustrated and described with respect to an example of a fluid transferring hose 1 in the above-mentioned embodiment, it is obvious that equivalent alterations and modifications will occur to those skilled in the art upon the reading and understanding of this specification. The present invention is satisfactorily applicable to other hoses of different purposes that have similar problems, so far as any of those hoses is provided with at least one fiber-reinforced layer between an internal rubber layer and a covering rubber layer. In such cases, at least one fiber-reinforced layer test body substantially identical in material and structure to the fiber-reinforced layer may be

provided in a retrievable position. The present invention includes all such equivalent alterations and modifications, and is limited only by the scope of the appended claims.

Example

A fluid transferring hose having a constitution shown in Fig. 3 was fabricated, in which two layers of fiber-reinforced layer test bodies virtually identical in material and structure to the fiber-reinforced layers were disposed so as to be exposed on a covering rubber layer. As for dimensions of the hose, an outside diameter at a central portion was 967 mm, a maximum outside diameter in the vicinity of an end portion was 1,057 mm, and a total length of the hose was 10.7 m.

This test hose was subjected to deterioration under a testing condition as described below, and then destroyed for retrieving fiber-reinforced layer test bodies and fiber-reinforced layers thereof. When the deterioration states between the fiber-reinforced layer test bodies and the fiber-reinforced layers were compared, the result showed that they were in an approximately equal deterioration state.

The test hose, with its opposite ends left open and with no pressure applied thereto, was set to a hose bending test machine. The test hose set to the machine was bent from its straight state to its bending state with a bending radius of 3600 mm and the bending state was kept for 10 minutes. This bending step was repeated until the bending force applied to the test hose decreased to less than 90% of the initial force.

As described above, in the present invention, a fiber-reinforced layer test body substantially identical in material and structure to a fiber-reinforced layer is disposed in a retrievable position. Accordingly, changes of physical properties of the fiber-reinforced layer with the passage of time can be determined by retrieving the fiber-reinforced layer test body that experiences virtually the same changes with the passage of time as those of the fiber-reinforced layer to measure the changes of the physical properties with passage of time with respect to the retrieved fiber-reinforced layer test body. As a result, estimation of a deterioration state of the fiber-reinforced layer becomes feasible without destroying the hose. In addition, since an operation for detaching the hose is not required and the hose

checked for its deterioration state remains continuously usable, a cost for measuring the deterioration state can be reduced.

CLAIMS:**1. A deterioration measuring method of a hose comprising the steps of:**

disposing at least one fiber-reinforced layer test body in a retrievable position of the hose in which at least one fiber-reinforced layer composed of fiber cords covered with rubber is provided between an internal rubber layer and a covering rubber layer, said fiber-reinforced layer test body being substantially identical in material and structure to said fiber-reinforced layer;

retrieving at least one part of said fiber-reinforced layer test body after being used for a certain period of time;

measuring changes of physical properties of the retrieved fiber-reinforced layer test body with the passage of time; and

estimating a deterioration state of said fiber-reinforced layer from the changes of the physical properties with the passage of time.



INVESTOR IN PEOPLE

Application No: GB 0214905.2
Claims searched: 1

Examiner: Damien J Huxley
Date of search: 14 August 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): F2P: PC9, PC13, PC26, PC29, PTBR, PTBX, PTX
G1S: SBW, SCX, SLA, SNX, SXX

Int Cl (Ed.7): F16L: 9/00, 9/12, 9/14, 9/18, 11/0, 11/04, 11/12, 57/00

Other: ONLINE: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2261956 A (BRITISH NUCLEAR FUELS) see the second paragraph of the first page and the figures especially.	
A	WO 00/79242 A1 (CURO AS) see the test body 20 of figure 4 in particular.	
A	US 4605065 (HUGHES TOOL COMPANY) see the monitoring coupon 59 detachably secured to the gas well conduit	

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